REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. Agency Use Only (*Leave blank*).

2. Report Date.
1990

3. Report Type and Dates Covered.
Abstract

4. Title and Subtitle.

Glint Removal from Multispectral Imagery Over Clear Water

5. Funding Numbers.

Program Element No 0602435N
Project No 3585
Task No. MOG
Accession No DN255031

6. Author(s).

Maria T. Kalcic and Stephen C. Lingsch

7. Performing Organization Name(s) and Address(es).

Naval Oceanographic and Atmospheric Research Laboratory
Stennis Space Center, MS 39529-5004

8. Performing Organization Report Number.

AB 90:351:042

9. Sponsoring/Monitoring Agency Name(s) and Address(es).

Naval Oceanographic and Atmospheric Research Laboratory
Stennis Space Center, MS 39529-5004

10. Sponsoring/Monitoring Agency Report Number.

AB 90:351:042

11. Supplementary Notes.

IGARSS

12a. Distribution/Availability Statement.

Approved for public release; distribution is unlimited.

12b. Distribution Code.

13. Abstract (*Maximum 200 words*).

Multispectral imagery over clear water provides information about the seafloor, in shallow coastal waters up to 20 m, which can be used to model depth, bottom type and seafloor texture. Glint, or specular reflection off the sea surface, is often present, thus masking the effect of bottom reflectance on algorithms which model the seafloor. Glint can be effectively removed in cases where the water is very clear due to the high correlation of glinted surfaces over multiple bandwidths. This information, used in conjunction with differences in attenuation between the visible and infrared portions of the electromagnetic spectrum, were used by Lyzenga [1] to derive a method for glint removal. The technique presented here expounds on that method by adding a texture technique to break out bright areas, such as white sandy shoals, that sometimes alias as glint, but have different texture, and by adding a quadratic term to the correction model.

14. Subject Terms.

(U) Hydrography; (U) Bathymetry; (U) Optical Properties; (U) Remote Sensing; (U) Reverberation

15. Number of Pages.
1

16. Price Code.

17. Security Classification of Report.	18. Security Classification of This Page	19. Security Classification of Abstract.	20. Limitation of Abstract.
Unclassified	Unclassified	Unclassified	SAR

GLINT REMOVAL FROM MULTISPECTRAL IMAGERY OVER CLEAR WATER

Maria T. Kalcic
Stephen C. Lingsch

Naval Oceanographic and Atmospheric Research Laboratory (NOARL)
Stennis Space Center, MS 39529-5004

Multispectral imagery over clear water provides information about the seafloor, in shallow coastal waters up to 20m, which can be used to model depth, bottom type and seafloor texture. Glint, or specular reflection off the sea surface, is often present, thus masking the effect of bottom reflectance on algorithms which model the seafloor. Glint can be effectively removed in cases where the water is very clear due to the high correlation of glinted surfaces over multiple bandwidths. This information used in conjunction with differences in attenuation between the visible and infrared portions of the electromagnetic spectrum were used by Lyzenga [1] to derive a method for glint removal. The technique presented here expounds on that method by adding a texture technique to break out bright areas, such as white sandy shoals, that sometimes alias as glint, but have different texture, and by adding a quadratic term to the correction model.

BACKGROUND

Light in the range from 350-575μ has a transmittance rate greater than 90% through the water column in pure sea water [2]. In the near infrared region, between 750-775μ, the transmittance rate falls off to below 10%. Since there is little or no penetration in the near infrared, the commonality between the visible and near-infrared bands is restricted to the surface. Glint, being strictly a surface feature, generates a high degree of correlation between the visible and near IR bands. In the absence of glint, there is very little correlation. Only in the case where the water is highly laden with particulates such as sediment, algae, etc., is the correlation high in the absence of glint. The technique requires relatively clear water, and a correlation, $r \geq .90$, to be effective. In cases where the water is not clear, most of the signal in the few upper centimeters of the water column is corrected out.

The method discussed here is a variation of Lyzenga's method, with the inclusion of a squared term in the model. The glint correction for the visible-band i based on the IR-band j takes the form:

$$\Delta Y_i = \alpha(Y_j - \bar{Y}_j) + \beta(Y^2_j - \bar{Y}^2_j)$$

The corrected visible-band signal is given by

$$\hat{Y}_i = Y_i - \Delta Y_i$$

where:

Y_i	= Raw signal for visible band,
Y_j	= Raw signal for near-IR band,
$\bar{Y}_j$	= Mean IR signal, non-glint deep water,
$\bar{Y}^2_j$	= Mean IR signal squared, non-glint deep water, and
α,β	= Regression coefficients.

Application of this model requires the identification of suitable non-glint deep water regions over which the averages $\bar{Y}_j$ and $\bar{Y}^2_j$ are computed. To compute the regression coefficients, each of the visible bands are regressed against the near IR band. The region where the coefficients are computed requires a deep water region containing both glint and non-glint.

RESULTS

The glint correction, used in conjunction with a texture mapping algorithm, allow for differentiation and correction of glinted areas of the sea surface with minimal correction of non-glint features. The algorithm has been successfully used on data collected with the NOARL multispectral scanner over shallow water areas in the Florida Keys and near Panama City, Fla. Results derived using imagery over waters around Horn Island, off the cost of Biloxi, Ms. were not as good as those in the clearer waters around Florida, emphasizing the limitations of the algorithm to clear coastal waters. Cases where shoals were slightly beneath the water line and had high reflectances similar to glint were cleared up by using a texture analysis of the neighborhood surrounding the highly reflective water pixels.

REFERENCES

[1] D.R. Lyzenga, "Shallow-water bathymetry using combined lidar and passive multispectral scanner data," *Remote Sensing, vol. 6:1*, pp. 115-125, 1985.

[2] Jerlov, N.G., *Optical Oceanography*, New

CH2825-8/90/0000-01831/$01.00